Fallowed Area Mapping for Drought Impact Reporting and Decision Making

James Verdin, Prasad Thenkabail, and John Dwyer, USGS
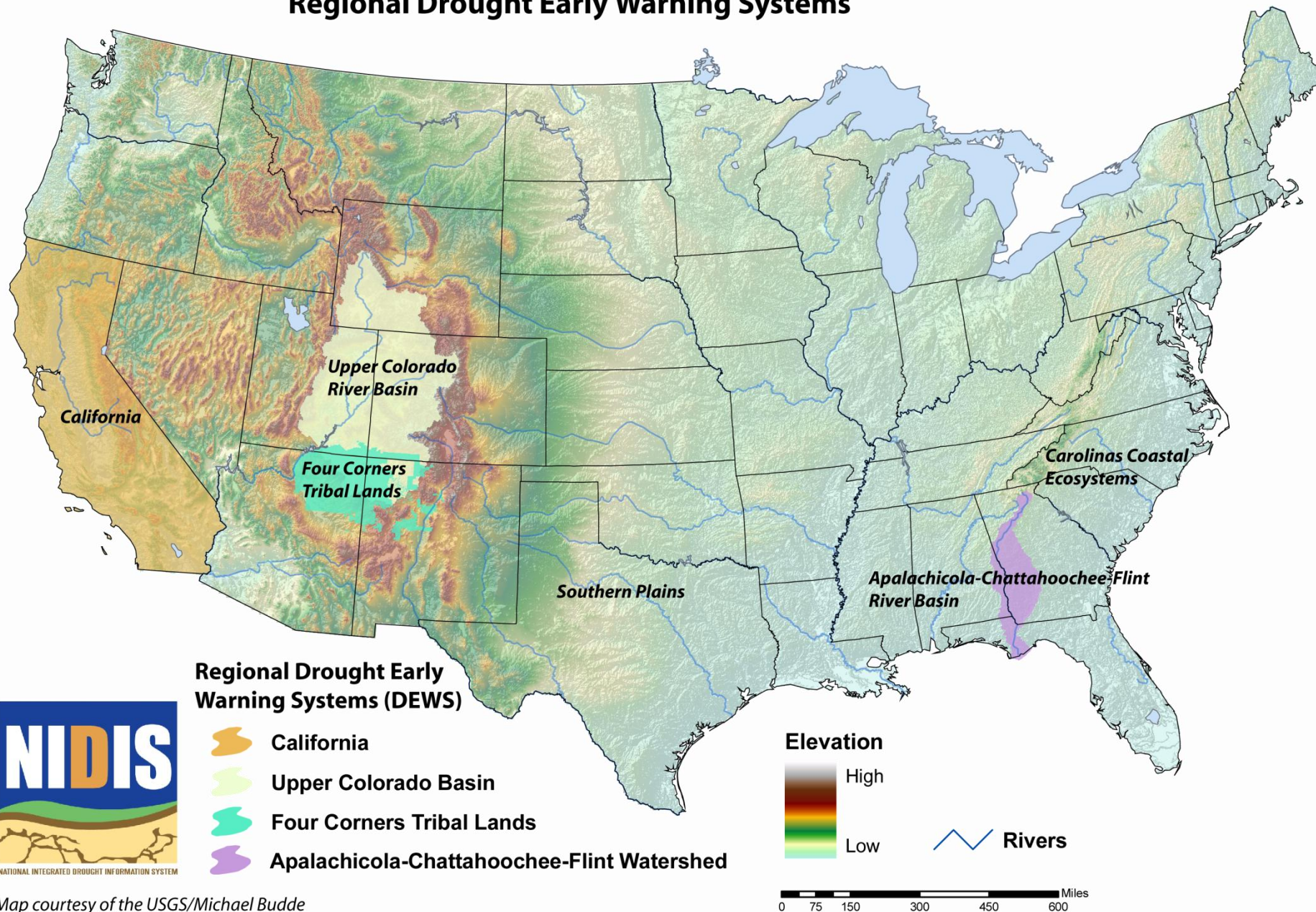
Rick Mueller and Audra Zakzeski, USDA NASS

Forrest Melton, Lee Johnson, Carolyn Rosevelt, CSU Monterey Bay / NASA Ames

Jeanine Jones, California Department of Water Resources

Rama Nemani, NASA Ames Research Center

NASA ASP Water Resources PI Team Meeting

September 5, 2012 – NASA Ames Research Center

National Integrated Drought Information System (NIDIS)
Regional Drought Early Warning Systems

California

Upper Colorado River Basin

Four Corners Tribal Lands

Southern Plains

Apalachicola-Chattahoochee-Flint River Basin

Carolinas Coastal Ecosystems

Regional Drought Early Warning Systems (DEWS)

- California
- Upper Colorado Basin
- Four Corners Tribal Lands
- Apalachicola-Chattahoochee-Flint Watershed

Elevation

High

Low

Rivers

NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Miles
0   75   150   300   450   600

Map courtesy of the USGS/Michael Budde

Drought Impact

CDWR Research Priorities for NIDIS
Cropping patterns during growing season
Information needed: product similar to NASS crop data layer for California, but on a monthly basis during growing season, with tool to compare CDL data in prior years.

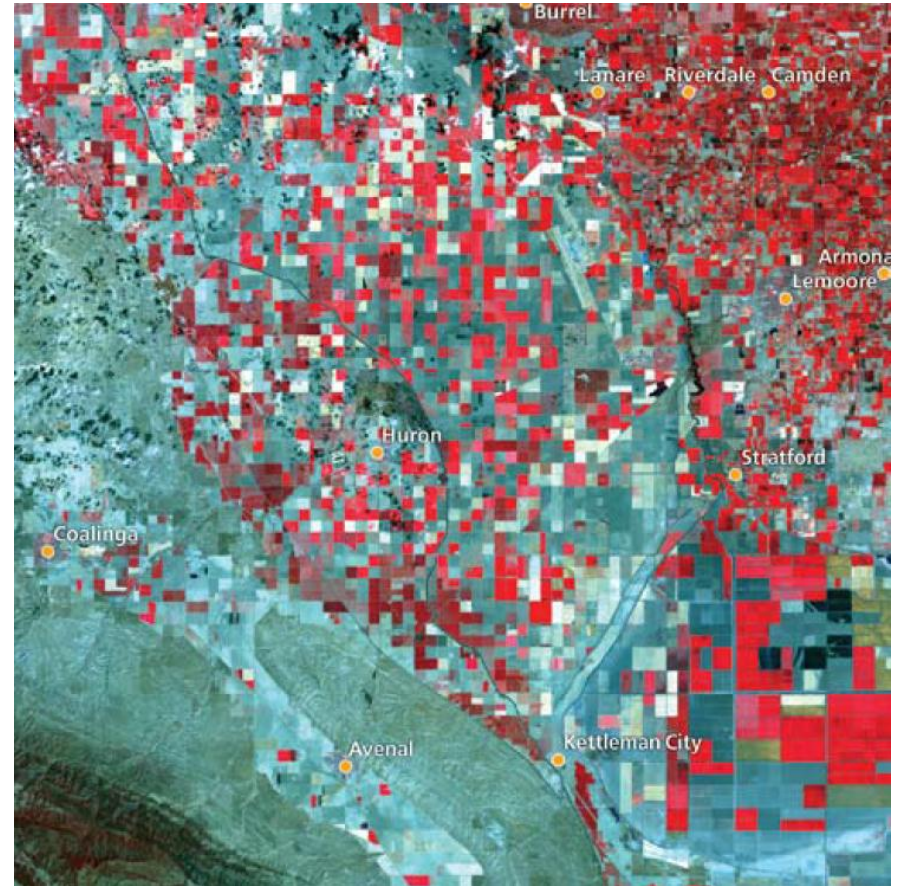Why needed: to identify extent of, or change from historical conditions in, fallowed acreage due to water shortage.

Decisions this information supports: state concurrence in county-level requests for USDA drought disaster designations, state proclamations of emergency pursuant to the California Emergency Services Act, state priorities for providing assistance with and processing of local water transfer requests

Limitations of presently available information: As NASS says: "The CDL is considered confidential and market sensitive during the growing season and we cannot release it until after NASS' official year end county estimates are published. Furthermore, the CDL is considered preliminary during the growing season and could be misleading to our customers, as we continue to receive updated ground truth and satellite imagery throughout the season."
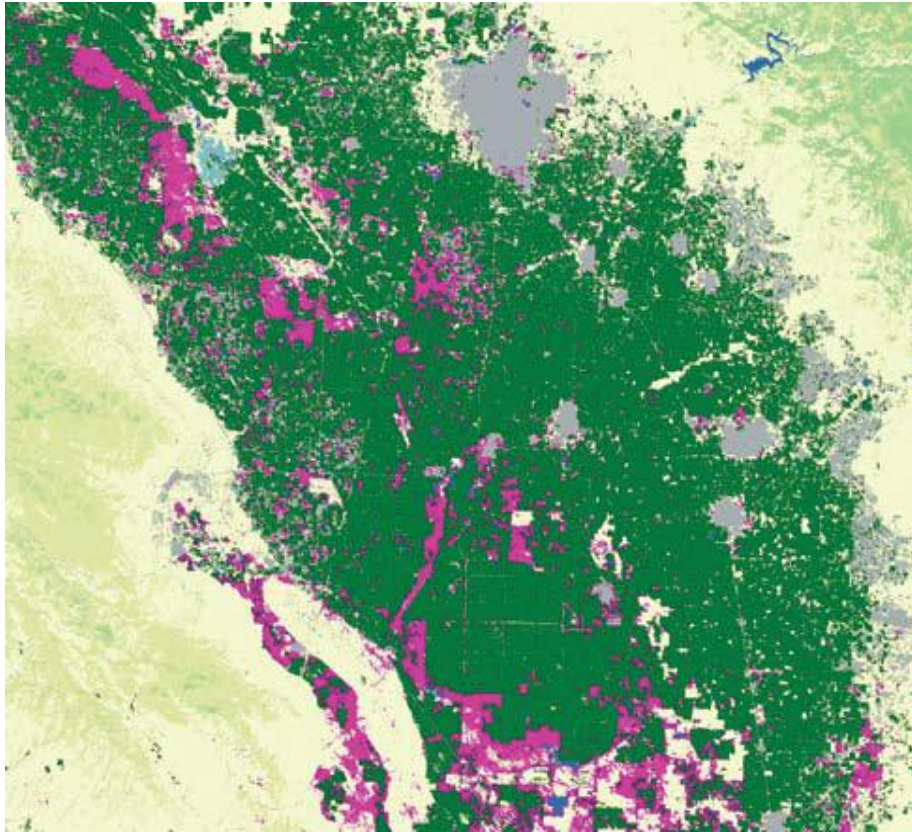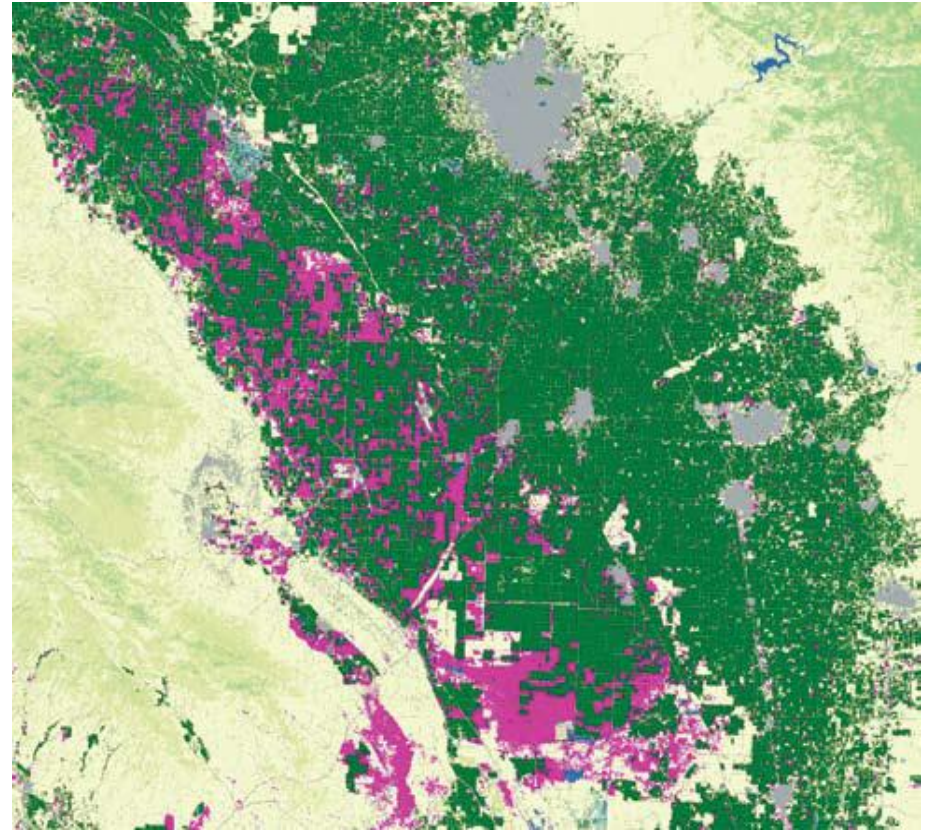
The Landsat View
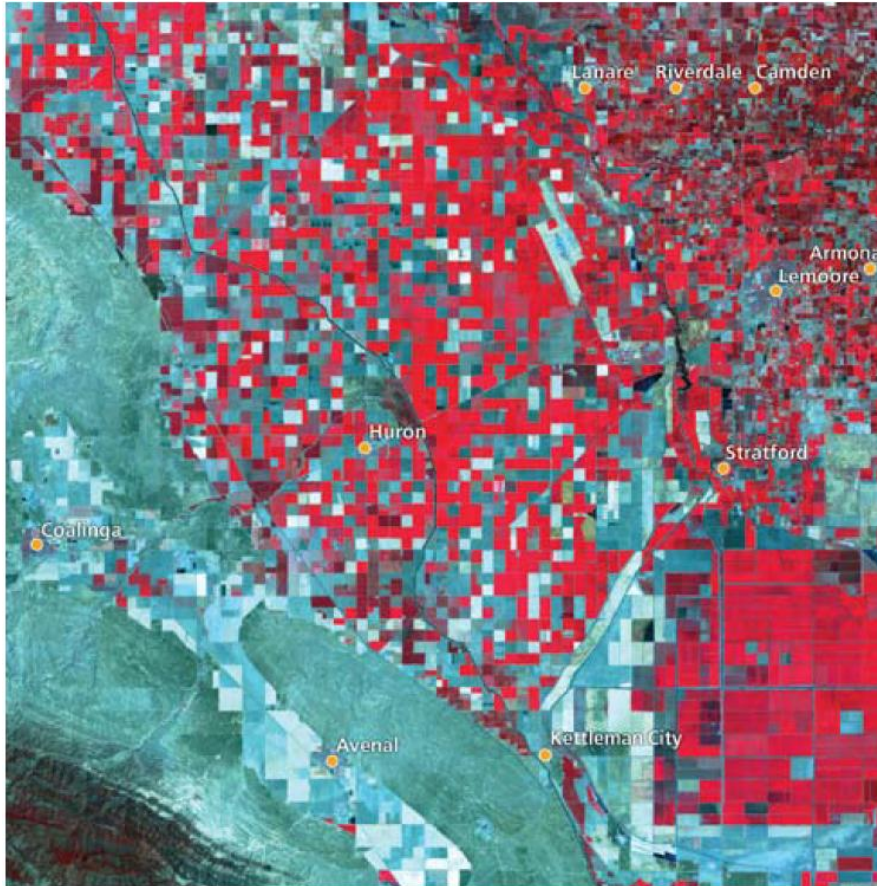
2007

2009

From: **California's Drought of 2007-2009: An Overview**

California Department of Water Resources, 2010

USDA NASS fallowed land mapping

2007
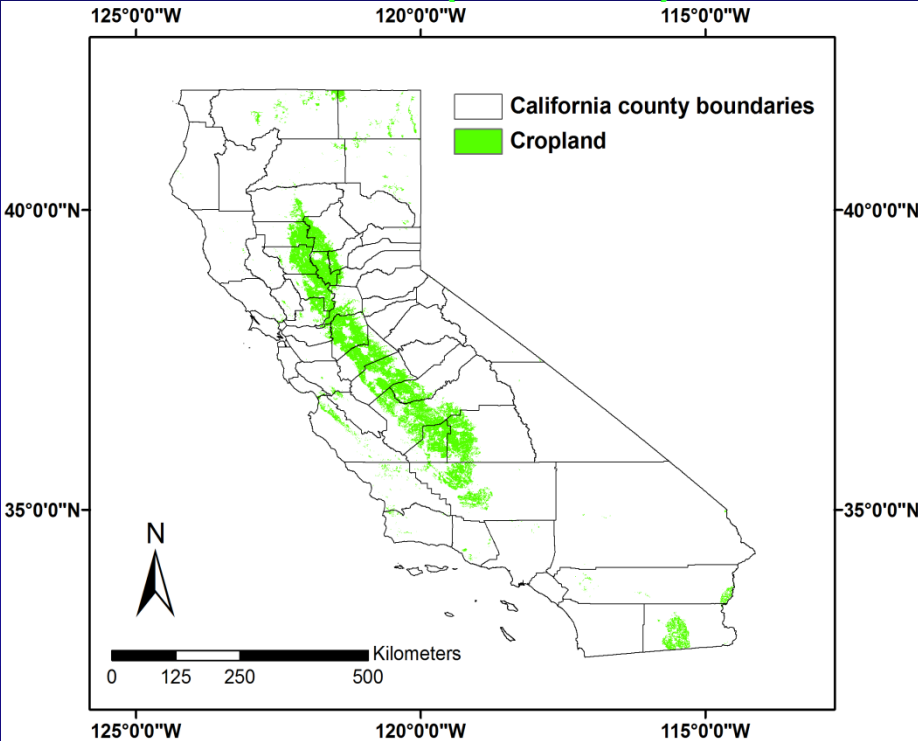
2009

Stakeholder requirements

- **Monthly tabular acreage summaries by county for April - September**

- **Latency of no more than two weeks**

- **Uncertainty as high as +/- 25% is tolerable**
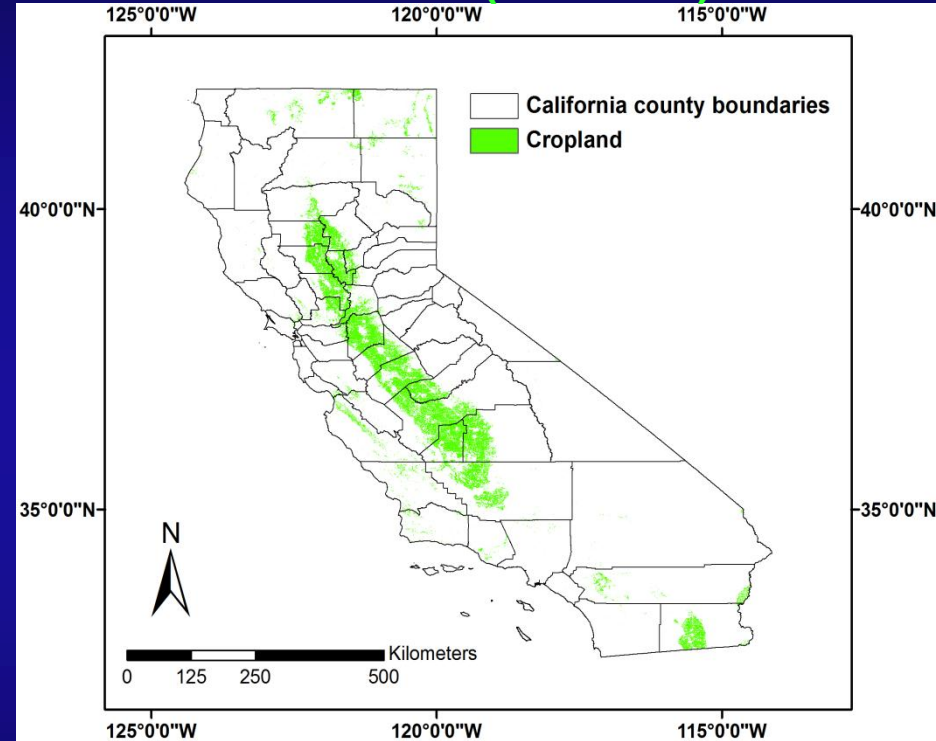
- **Historical figures required for context**

≋USGS

Automated Cropland Classification Algorithm (ACCA)
ACL2010 (algorithm) versus TCL2010 (USDA CDL)

ACCA-derived cropland layer for 2010 (ACL2010)

USDA cropland truth layer for 2010 (TCL2010)

Note: once the data layer is ready, this layer was generated automatically by ACCA in about ~60 minutes on DELL Precision T7400 desktop
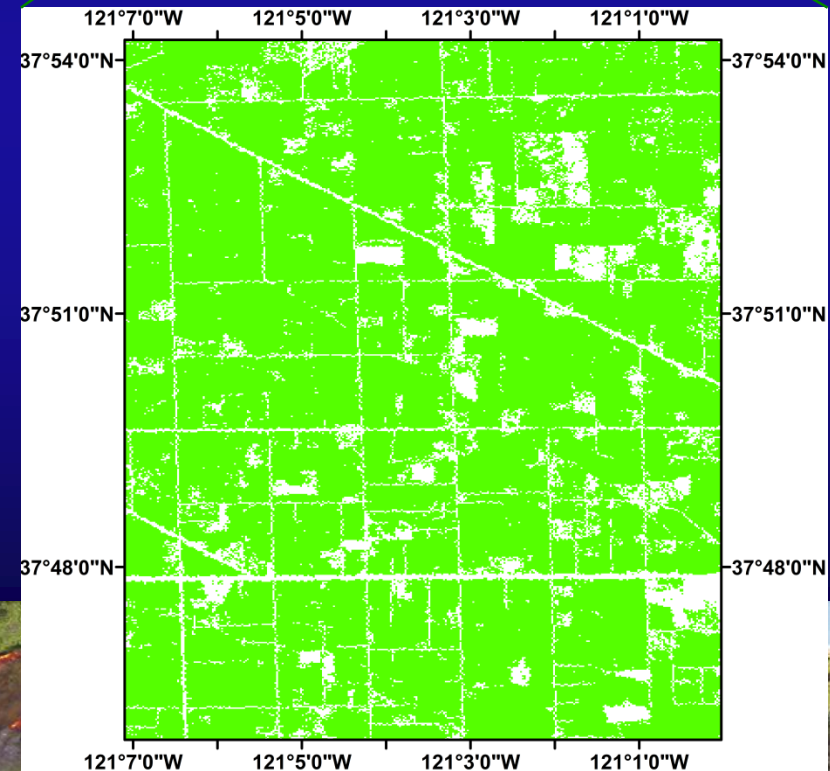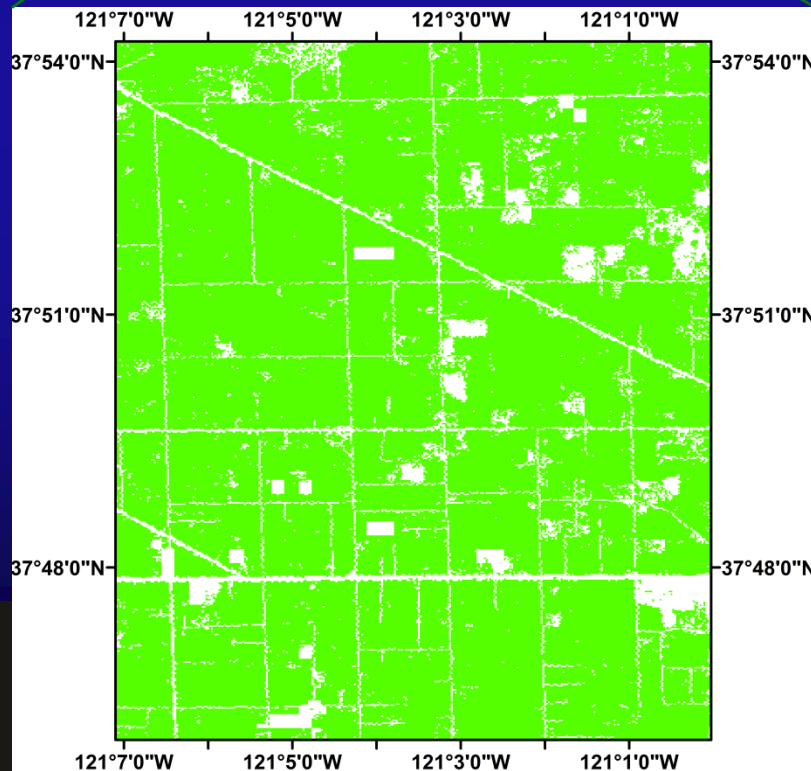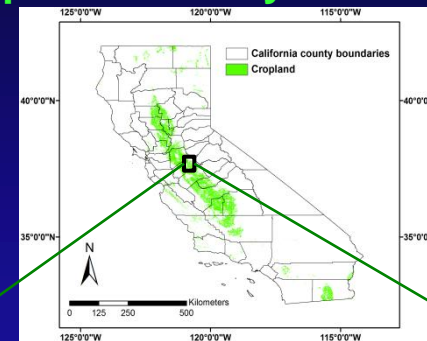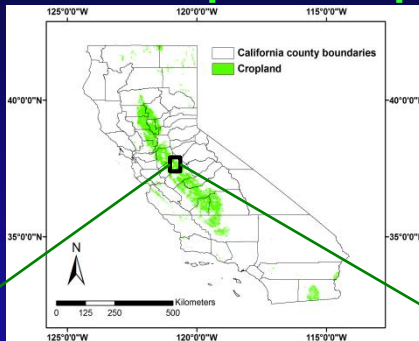
Automated Cropland Classification Algorithm (ACCA)
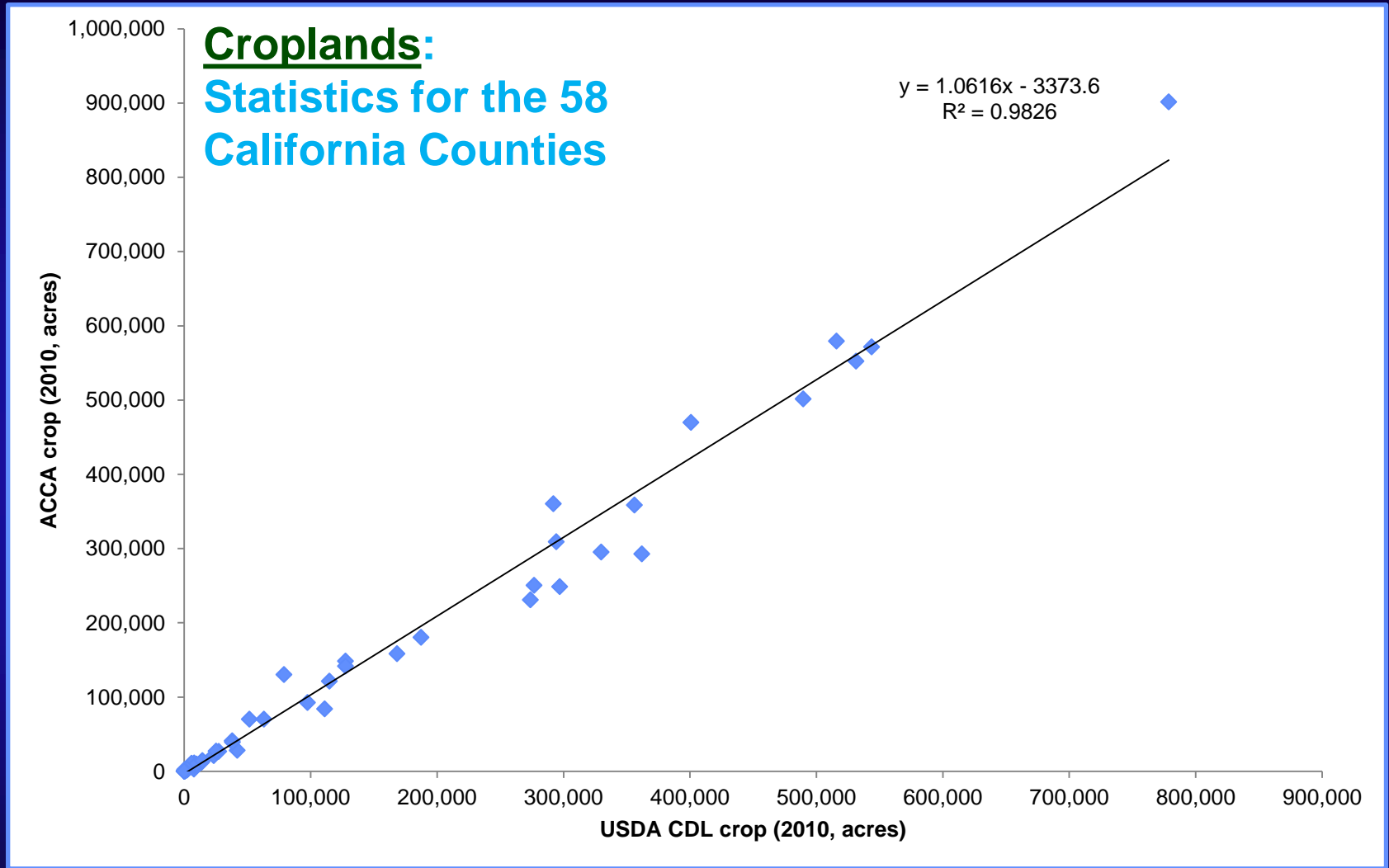# ACL2010 (algorithm) versus TCL2010 (USDA CDL)

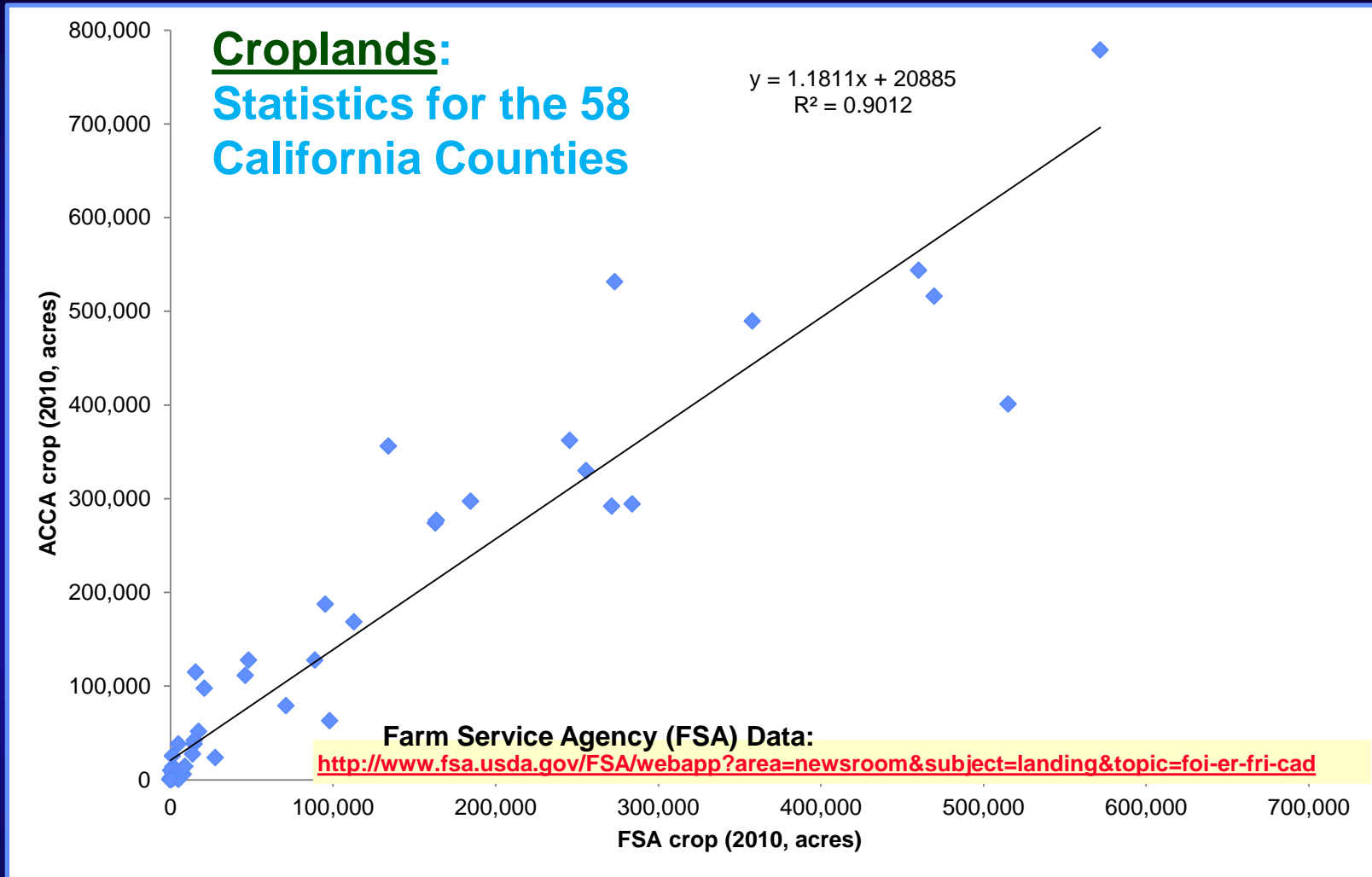### ACCA-derived cropland map 2010 (ACL2010)   USDA cropland data layer 2010 (TCL2010)

ACL2010 (algorithm) versus TCL2010 (USDA CDL)

Croplands:
Statistics for the 58
California Counties

$y = 1.0616x - 3373.6$
$R^2 = 0.9826$

ACCA crop (2010, acres)

USDA CDL crop (2010, acres)

ACL2010 (algorithm) versus FSA2010 (FSA Stats)

Croplands:

Statistics for the 58 California Counties

$$y = 1.1811x + 20885$$
$$R^2 = 0.9012$$

ACCA crop (2010, acres) [y-axis]

FSA crop (2010, acres) [x-axis]

Farm Service Agency (FSA) Data:
http://www.fsa.usda.gov/FSA/webapp?area=newsroom&subject=landing&topic=foi-er-fri-cad

2012 Cropland Data Layer Idle Fields
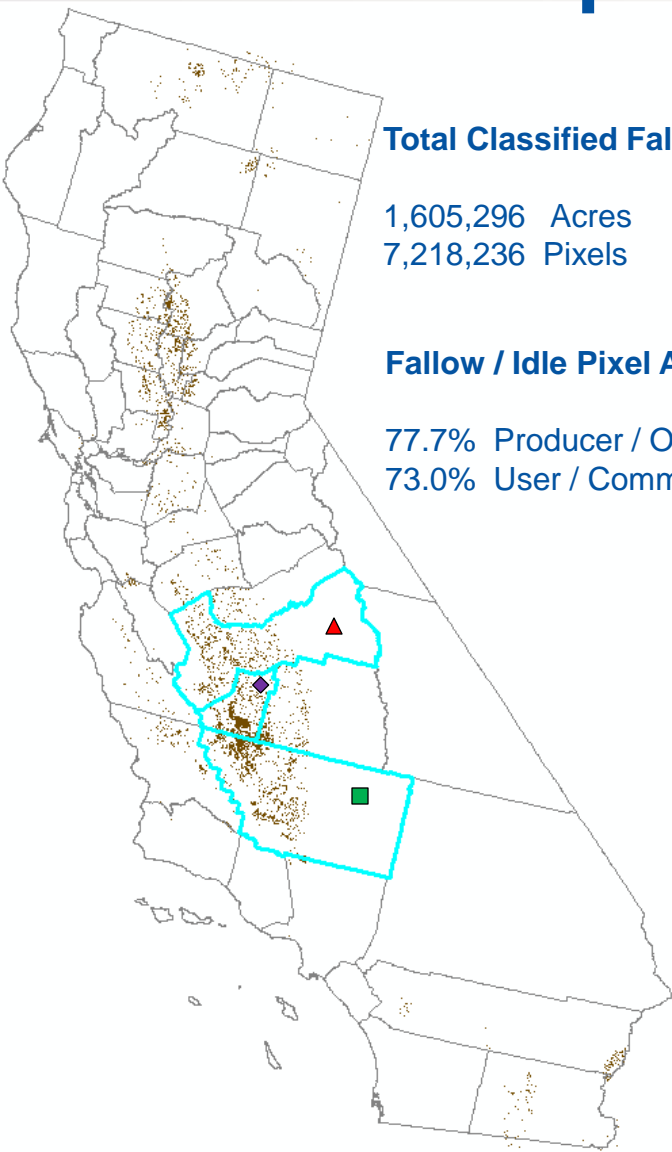
Total Classified Fallow / Idle

1,605,296 Acres
7,218,236 Pixels
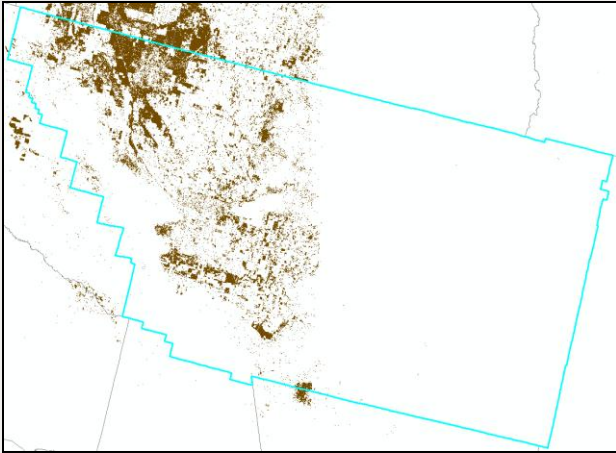
Fallow / Idle Pixel Accuracy

77.7% Producer / Ommision
73.0% User / Commission

Total Fallow / Idle Acres by CDL Iteration

County		September	August	June
		Cropland Data Layer Iterations		
Kern	■	366,649	345,599	322,500
Fresno	▲	208,711	191,436	196,443
Kings	◆	203,170	159,347	142,714
Tulare		113,399	124,151	110,825
Butte		80,742	76,546	52,709
Yolo		67,341	58,611	69,525
Sutter		52,897	45,125	32,613
Siskiyou		45,175	46,852	49,840
Colusa		43,493	40,556	22,546
Glenn		38,048	38,240	25,552

USDA
AGRICULTURE COUNTS
NASS

2012 September Cropland Data Layer Idle Fields
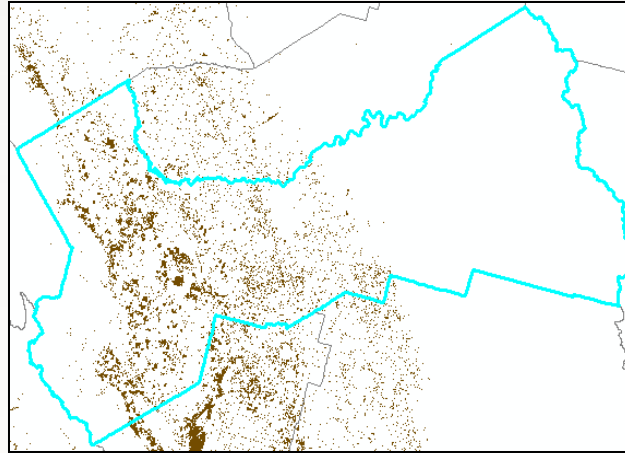

Kern County

Total Classified Fallow / Idle

366,649   Acres
1,648,644   Pixels

Fallow / Idle Pixel Accuracy

84.3% Producer / Omission
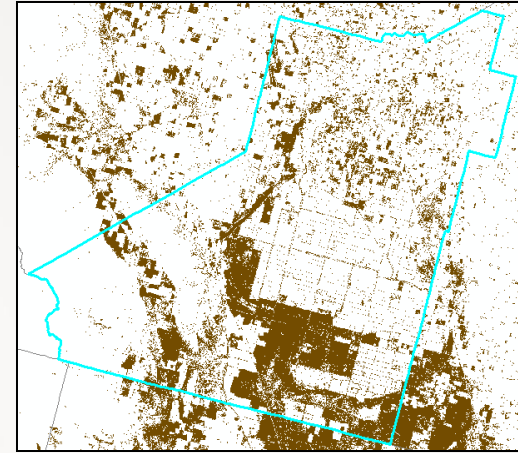66.3% User / Commission

Fresno County

Total Classified Fallow / Idle

208,711   Acres
938,472   Pixels

Fallow / Idle Pixel Accuracy

69.6% Producer / Omission
59.7% User / Commission

Kings County

Total Classified Fallow / Idle

203,170   Acres
913,556   Pixels

Fallow / Idle Pixel Accuracy

85.4% Producer / Omission
60.1% User / Commission

USDA

AGRICULTURE COUNTS · NASS

Validation:
## Ground Surveys of Field Conditions

- Data collection from April/May and May/June 2012; final survey planned in Sept. 2012
- ~1000 fields surveyed along 8 transects
- Data used in accuracy assessment of fallowed area maps
- **Support for ground surveys provided by NIDIS Program Office**

Refining Early Season Fallowed Area Classifications

- Irrigated agricultural crops have phenological patterns that are distinct from fallowed lands and grasslands

- Currently using Landsat and MODIS data archives for California and field boundary data to calculate metrics for all fields in California for 2007-2012

- Will apply metrics to refine fallowed area classifications by identifying periods during which each field is typically bare
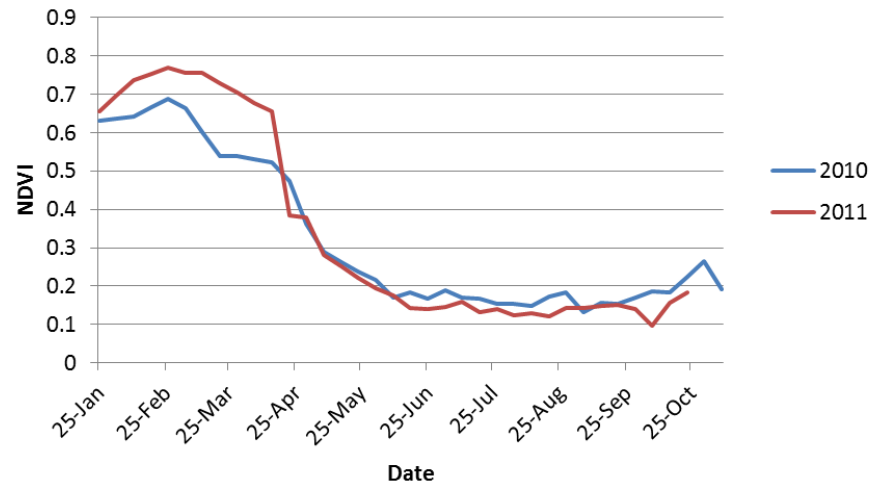

Seasonal NDVI Profiles, Fallow
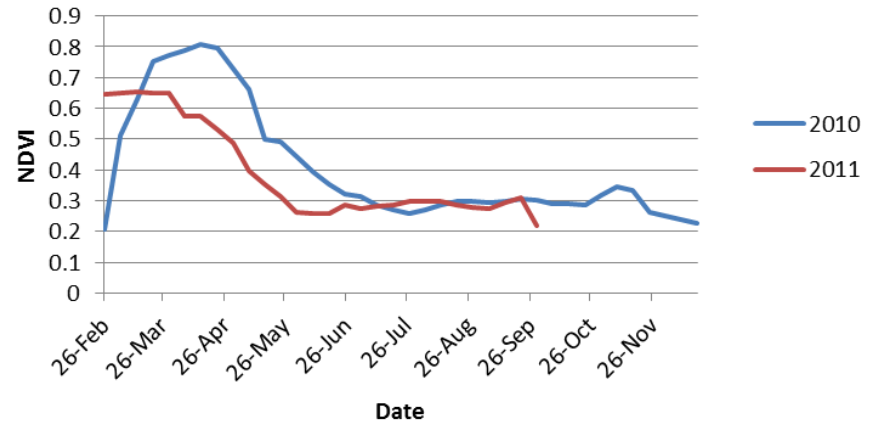
Seasonal NDVI Profiles, Tomato
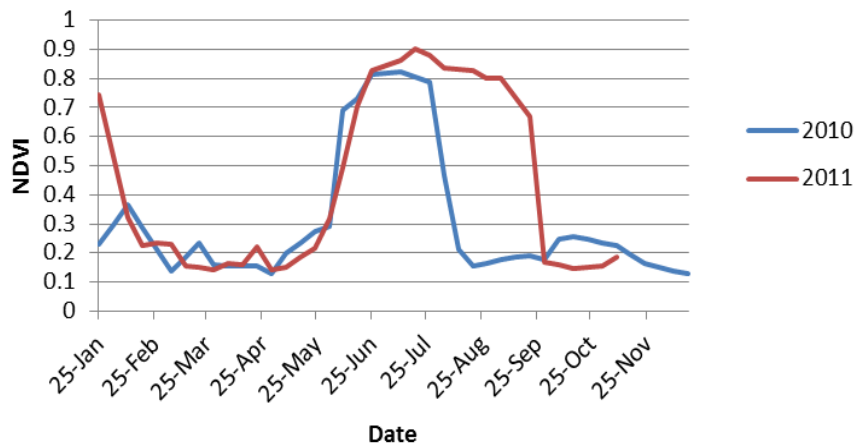
Seasonal NDVI Profiles, Grassland

Testing Alternate Satellite Indices

- During April-June, it can be difficult to separate fallowed fields and fields which have been tilled and prepared for planting in June-July

- Investigating alternate satellite indices to supplement use of crop phenology derived from NDVI timeseries and decision tree classifiers to separate fallowed fields early in the season
    - Land surface temperature
    - Normalized Difference Moisture Index (NDMI)
    - Soil Adjusted Vegetation Index (SAVI)
    - Tasseled cap wetness
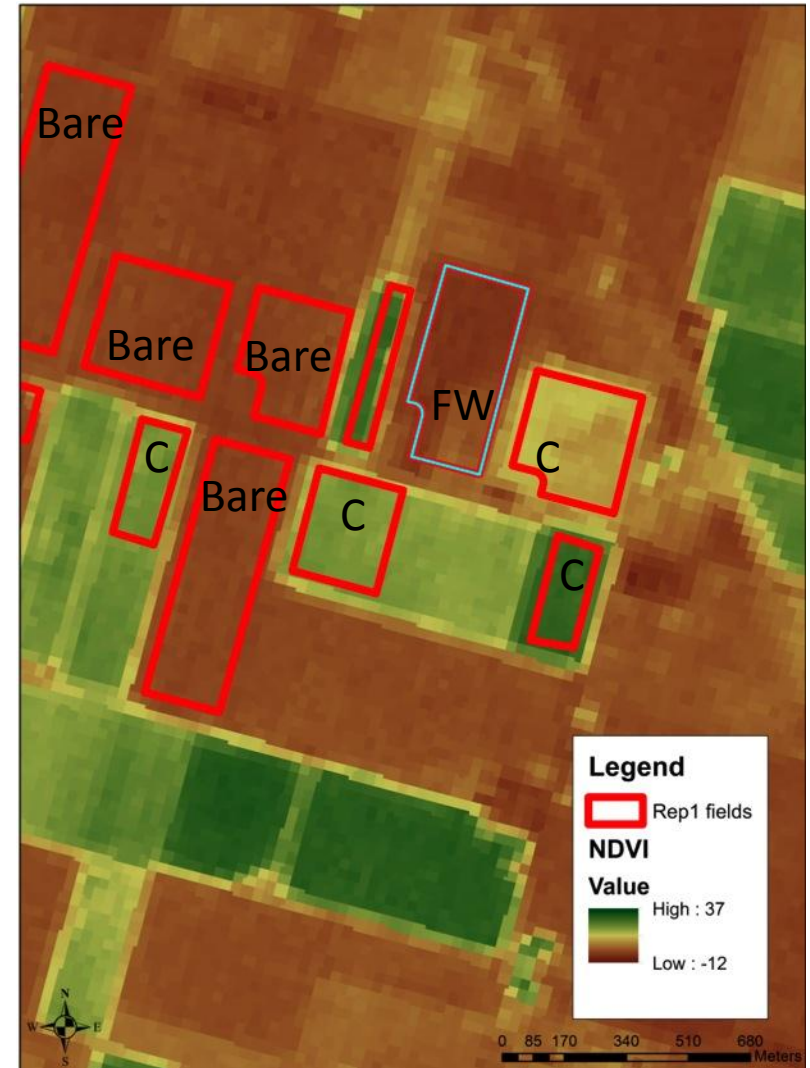
NDVI, San Joaquin Valley, CA, April 30, 2012

Enterprise Science Processing Architecture

- The ESPA Framework has been created to support Terrestrial Monitoring applications at USGS/EROS

- The EROS/Enterprise Science Processing Architecture is designed to enable science users to bring their algorithms to the archive to better and more quickly serve their needs

- Common functions that are utilized by science users include:

  - Re-projection
  - Re-sampling
  - Compositing
  - Higher level processing

  - Multi-input products
  - Mosaicing
  - Subsetting

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Questions?

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